

TRANSPORTATION TRANSFORMATION

Recycling and Conservation in California

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Reduction, reuse, energy conservation, and recycling are incorporated into the design, planning, construction, and maintenance of California's highway system. These practices have become an important element in the California Department of Transportation's way of doing business, recognizing that conserving resources can save tax dollars and help address the problem of diminishing landfill space.

Two specific efforts at Caltrans are the hardware recycling program and the integration of waste materials into pavement maintenance and construction. The department also maintains internal programs to encourage employees to conserve resources, and has engaged in research and field testing of applications for recycled rubber, guardrails, and plastic.

RECYCLING HARDWARE

Construction projects on California highways often involve removing or disturbing existing facilities to accommodate new construction. For example, highway widening, realignment, or safety improvements could dislocate lights, signs, guardrails, and fencing. Although many of these items are obsolete after removal, most conform to current standards and have 10 to 50 years of useful life remaining.

Design engineers have a range of options for dispensing with old hardware. Removal and disposal require the specification and purchase of new materials for replacement. Reconstruction of the original hardware within the same project reduces overall project cost, alleviates storage requirements at the construction site, and eliminates possible delays because of purchasing and shipping. Removal for salvaging at special facilities allows replacement hardware to be stockpiled for use on other projects, creating the opportunity to reduce costs on new construction projects while saving natural resources.

Reconstructing suitable removed hardware within the same project is desirable because it is less costly than removal, disposal, and replacement with new materials. Items with adequate

remaining service life that cannot be immediately reused are salvaged and stockpiled at a central storage facility or a Caltrans district recycling center for use on construction projects in the future. A computer-supported inventory management system maintains records of salvaged materials statewide. This system also produces a data base for designers that identifies salvaged items available for construction and maintenance work.

Items stored at the recycling yards include roadside sign posts and spacer blocks (wood, metal, and laminated); overhead sign structures; flared end sections (concrete and metal); drainage inlet frames, grates, and covers; manhole frames, covers, and adjustment rings; chain-link fence fabric; wood and metal posts; gates; metal-beam guardrail; metal-beam barriers; lighting standards and high-pressure sodium luminaries; and traffic controllers.

The hardware that is reused, salvaged, and reconstructed in the largest quantities is metal-beam guardrail. In fiscal year 1994 Caltrans salvaged 12 600 meters (13,780 yards) of this hardware, reconstructed 60 900 meters (66,600 yards) and reinstalled 200 meters (219 yards) of it from salvage.

RECYCLED MATERIALS IN PAVEMENT

Caltrans has worked with recycled materials in pavement sections for many years. Most recently Caltrans has enhanced its pavement recycling program to meet the challenge of reusing crumb-rubber modified asphalt, as originally required by the Intermodal Surface Transportation Efficiency Act. Crumb rubber from discarded tires may be used in asphalt-rubber binder, rubberized asphalt concrete, stress-absorbing membrane interlayer, asphalt-rubber seal coat, and crack sealant.

Slag aggregate, a steel-mill by-product, may be recycled into imported borrow, aggregate subbase, aggregate base, and asphalt concrete. Waste glass has a variety of new uses, from incorporation into subbase or aggregate base to integration into a variety of pavement markings. Caltrans already reclaims asphalt concrete, portland cement concrete, lean concrete base, and cement-treated base.

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The use of rubberized and recycled asphalt concrete is selected for project locations on a case-by-case basis by Caltrans design engineers and planners. In 1994 the department placed 62 500 metric tons (68,750 tons) of recycled asphalt concrete and 64 500 metric tons (70,950 tons) of rubberized asphalt concrete; local agencies also placed this material. Caltrans' Office of Local Programs is receiving preliminary reports from California's local agencies indicating that they are approaching the 25 percent level for recycled materials. This figure should be viewed with cautious optimism until it is fully documented.

At this time Caltrans is not documenting the use of reclaimed materials such as slag and glass in subbase and base. Although project specifications do not require the use of recycled or reclaimed materials at any percentage level, the inclusion of reclaimed or recycled materials is allowed, provided that all state design criteria and standards are met. Cost efficiency drives the use of reclaimed or recycled materials.

The ongoing Cypress Freeway reconstruction provides a good example of material reclamation practices. The 1989 Loma Prieta earthquake destroyed much of the elevated double-deck concrete portion of the freeway. Demolition of the collapsed structure yielded a large amount of concrete rubble which is being processed into usable base material. Among the factors that made this possible were the proximity of new construction work to the demolition site, and the amount of concrete rubble, which was large enough to justify the use of a rock crusher. These factors eliminated the need for disposal of the concrete and the purchase of new aggregate. The choice to use reclaimed or recycled material is the contractor's; in the case of the Cypress Freeway, it has been to the contractor's economic advantage to reprocess. Specifications are being developed to adopt a procedure requiring a contractor to notify the state whenever recycled materials are used.

Recycled glass beads are used extensively in thermoplastic and painted traffic striping and pavement marking on Caltrans projects, and recently adopted specifications require recycled glass to be incorporated into the manufacture of beads used for these purposes. The glass beads are placed uniformly on a painted or thermoplastic surface that has been freshly placed. They are applied at a rate of approximately 0.6 kilograms per liter (5 pounds per gallon) for paint and at a surface rate of 4 kilograms per 10 square meters (8 pounds per 100 square feet) for thermoplastic material.

Caltrans also cracks and seats old concrete pavement to conserve materials. Concrete pavement is cracked at regular intervals and seated

into the underlayment with a vibratory roller or similar machinery. The cracked concrete pavement can be used as a subbase to a new asphalt concrete overlay. In 1994, 856 000 square meters (1.02 million square yards) of crack-and-sealing were completed.

ONGOING AND NEW EFFORTS

In addition to specific efforts to conserve and reuse resources, Caltrans has internal policies for collecting and recycling paper, glass bottles, and aluminum cans. The state code requires a minimum recycled content in the paper it purchases, and uses re-refined automotive lubricants—including motor oil, power steering fluid, and transmission fluid—in its vehicles. These products are required by state law, as long as they meet departmental performance specifications, and cannot exceed the lowest quoted price for virgin lubrication products by more than 5 percent.

Through demonstration and experimental projects, Caltrans has tested new uses for recycled products. Recycled tires have been integrated into shoulder areas for erosion protection, into embankments, and into the tie-backs of retaining wall systems. At some rural locations, short retaining walls have been constructed from recycled guardrails. Recycled plastics have been used at two locations for soundwall noise barriers that met all normal design criteria. Caltrans has not yet standardized design and developed specifications for applications using salvaged tires and guardrails.

Recycling is a key element of the Caltrans business plan. The department will continue to develop and implement cost-effective recycling programs in the next century. Information on recent cost data, standard specifications, special provisions, and other information related to recycling is available to the public through the Internet.

Caltrans Internet address: <http://oe.dot.ca.gov>; FTP address: [oeftp.dot.ca.gov](ftp://oeftp.dot.ca.gov). General Caltrans information is also available at <http://www.dot.ca.gov>.



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Demolition activities related to reconstruction of Cypress Freeway in San Francisco (top), after Loma Prieta Earthquake in 1989 afforded Caltrans an opportunity to recycle several types of material, including reinforcing steel bars (center) and concrete rubble (bottom).